molecule, which can be accounted for quite simply in other ways; but it shows how prevalent is the idea that valency means, not only the power to do something, but that that power is always being exercised, and that in every chemical formula every unit of valency must be accounted for. This example is sufficient to illustrate the state of confusion about valency and chemical combination, which seems to grow more serious and more tangled every day.

The doctrine of Stereoisomerism as at present used may be compared to the fluid theory of electricity. It is a working theory which some day, perhaps, will be superseded, but no great advance is likely to be made until some more clear idea as to the meaning of valency can be brought into use. In the meantime experimental inquiry is undoubtedly proceeding rapidly, and will prepare the way for the next step in theory. To this end such a book as Bischoff's "Stereochemie" will afford much assistance in the laboratory, and can be safely recommended to all who are working in this direction. W. A. T.

CAVES AND SWALLOW-HOLES.

Les Abîmes, les eaux souterraines, les cavernes, les sources, la spelæologie. By E. A. Martel. 4 phototypes and 16 plans, with 100 smaller illustrations. (Paris: C. Delagrave, 1894.)

At the outset the author remarks that the man is happy who realises in ripe manhood a project of boyhood. As a youth he was fascinated by the stalactites of the cave of Gargas, and the underground stream near Eaux Chaudes. The impression, at a later date, was deepened by the marvels of Adelsberg; and a visit to Han-sur-lesse (Belgium) in 1888, determined him to explore thoroughly the swallow-holes and caves of Les Causses—the limestone plateaux to the south and west of the Cevennes and Auvergne—with which he had already made acquaintance. Here the rivers often flow through deep gorges—almost cañons, such as is illustrated by Fig. 1. In 1888 and the following year the author investigated the underground topography of the Departments of Lozère and Gard, and then extended his researches from Vaucluse to La Charente, going as far as the Puy-de-Dôme, the Côte-d'Or, and Provence, and, yet further afield, to Belgium, the Karst, and the Peloponnesus. Altogether he explored 230 "holes in the rock," which he thus classifies: Swallow-holes (*abîmes*), 110, into 90 of which no descent had been previously made; emissaries of rivers (*sources*), 40, up 30 of which no one had penetrated; caves, 80, of which 45 were but imperfectly known. Besides these he had sounded, without descending, 35 swallow-holes, and examined 55 large emissaries, which could not be entered. Plans were made of underground galleries, the total length of which amounts to 50 kilometres; rather more than half the work being done by himself, the rest by collaborators. The result of this indefatigable, and sometimes rather risky, work is the most complete original memoir on "cave hunting" that has ever been published, a quarto volume of nearly 600 pages, containing many plans, and still more numerous illustrations, the latter mostly from photographs, together with a full bibliography of the subject.

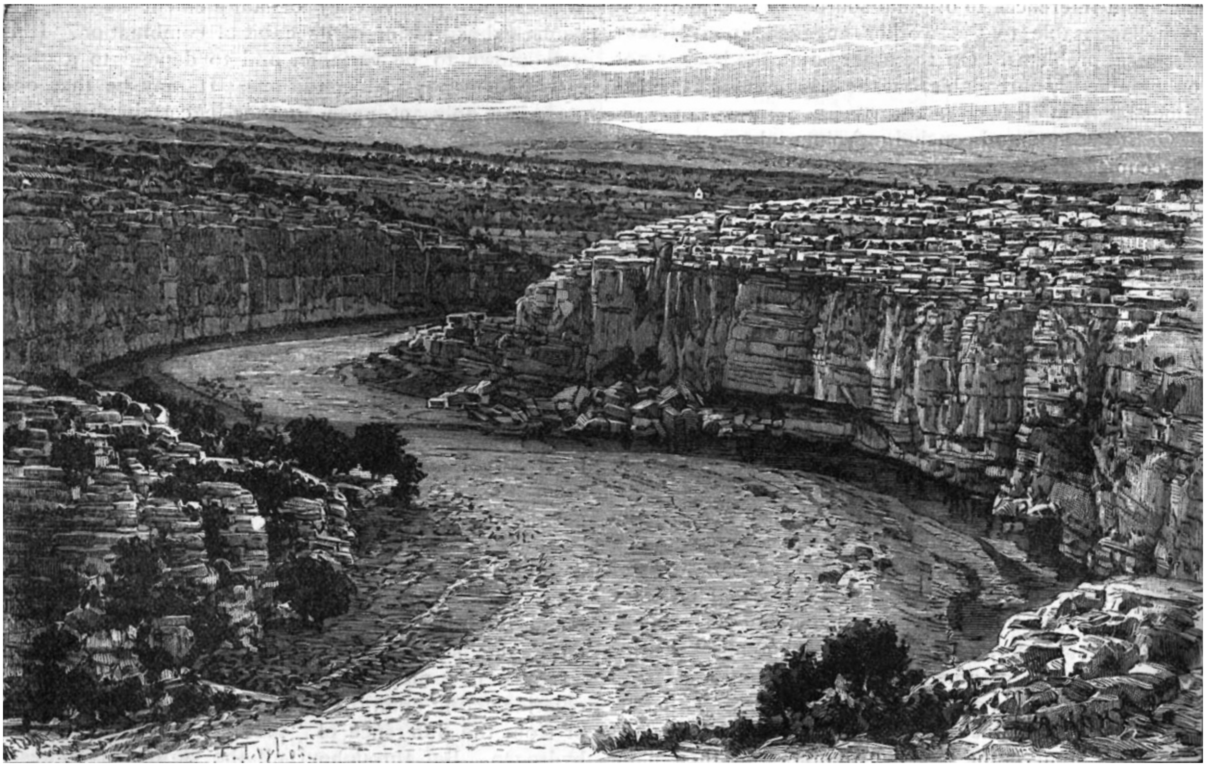

Fig. 1.—Cañon de la Baume.

To give any account of even the caverns of the Causses, which occupy the larger part of the book, would occupy too much space; so we content ourselves with a brief sketch of one of the most remarkable—that of Padirac, in the Causse de Grammat; and, after all, caves generally exhibit a strong family likeness. On a rocky plain a gulf, nearly forty yards across, opens out suddenly, as shown in Fig. 2, for which and the one on p. 410, we are indebted to the courtesy of the publishers. The greatest depth is just over twice the breadth, but a huge pile of débris rises from the bottom up to nearly fifty-nine yards from the surface. This leads on either side to a gallery. One of these ascends gently upwards, for about a couple of hundred yards, to a spot where a stream bursts from the rock. The other gallery, which is also traversed by this stream, extends for about a mile and three-quarters, following a rather serpentine course, which, in one part, bends at right angles to its former direction. At last it ends in a lake and a *cul de sac*. The cave is generally rather narrow, not many feet in width, but here and there broadens out into a large hall; the roof, also, rises and falls, its height not unfrequently being from forty to sixty feet—occasionally a good deal more. Padirac contains stalacites, stalagmites, and basin-shaped deposits of calcic carbonate; in short, is a thoroughly typical cave, with the not infrequent addition of a huge swallow-hole. Dozens of similar caverns may be found in this curious limestone region. They are abundant, under various names, in the Jura and in the limestone districts of the Alps, being most frequent in the more eastern region, where sometimes a bare rocky tract is almost riddled by swallow-holes (*dolinas*) great or small. From the Karst district they may be followed through the Alps of Dalmatia into the limestone region of Greece; they exist also in the carboniferous limestone of England, Belgium, and America. One might almost say *ubi calx*, *ibi spelunca*.

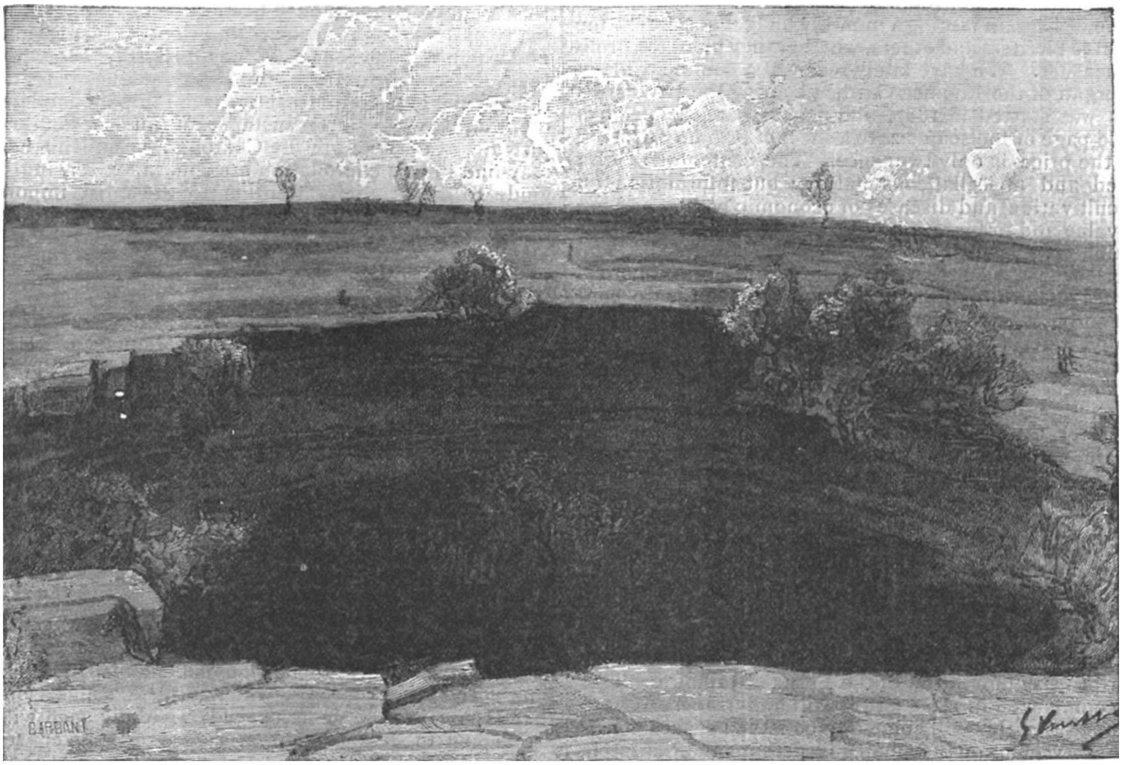

FIG. 2.—Shaft leading to the Cave of Padirac.

M. Martel notices, but appears to have paid less attention to, the curious caves called *glacières*, so pleasantly described by Canon Browne in his "Ice Caves of France and Switzerland." In these the walls are hung with sheets and festoons of ice, and thick masses of it cover the floors. In summer-time the temperature inside them keeps very near to the freezing-point. M. Martel suggests that in winter they become filled with cold air, which remains there like the carbonic anhydride in a *grotto del cane*. But such as we have seen, appear to be better explained as natural ice-houses, where the summer warmth is insufficient to dispose of the snow and ice which had accumulated in the winter.

Is it possible that occasionally these swallow-holes and caves may be memorials of an age when the climate was colder than it is at present? Both are sometimes dry. In the case of the cave, this may be explained by the water having worked out a new, and as yet undiscovered, path; but some swallow-holes open out, like the mouths of wells, on gentle slopes or rocky plains, apparently disconnected from any system of drainage. They seem too large to be explained—like those countless pipes in the rock of the *Steinerne Meer*—as only the work of rain. Is it possible that they were chiefly excavated in the Glacial epoch, when many elevated rocky plateaux would be buried under permanent, or nearly permanent, snow-beds, the drainage from which would give a supply of water, which was engulfed before it had the opportunity of excavating a glen? Some things seem not unfavourable to this suggestion. T. G. BONNEY.

OUR BOOK SHELF.

Bulletin of the Botanical Department, Jamaica. April 1887 to September 1894. Edited by the Director, W. Fawcett, B.Sc. (Published by the Department of Public Gardens and Plantations.)

SINCE the increase of botanical stations in the British West Indies, there has been greater activity in the older establishments, and the Directors have followed the example of Kew, in issuing a monthly budget of information useful to planters and others, whether they plant for profit or pleasure. We have lately received a complete file of the organ of the Jamaica Garden, bearing the above title. This was started in 1887, and it has increased from a single page of foolscap size to a sheet of ordinary octavo; and the price is only twopence. The contents are of a varied and miscellaneous nature; but information on the cultivation and diseases of economic plants, and on the value and preparation of their products, largely predominates. It includes not only the results of local experience; the editor has also drawn upon the numerous sources open to him, thanks to the more intimate connection between similar establishments throughout the empire, due, to a large extent, to the efforts of the Director of Kew.

Among other things, there are lists of the economic plants, of plants yielding edible fruits, and of trees useful either for timber or shade, cultivated in the Jamaica botanic garden. Botanical and common names are given, as well as the native countries of the respective plants, together with the prices (of seeds or plants) at which they are offered to the inhabitants of the island. The prices, it may be mentioned, are ridiculously low; merely nominal, in fact. Free grants are also made; but in order to avoid waste of valuable plants, the conditions are somewhat stringent, though not more so than an intelligent and earnest cultivator would cheerfully submit to. Another interesting feature is Mr. Jenman's descriptive enumeration of the Ferns of Jamaica. This was commenced in 1890, and is still unfinished. It is to be hoped that this will some day be issued separately, as the Fern-vegetation of Jamaica is perhaps the richest in the world, comprising between 400 and 500 species.

Die Maschinellen Hilfsmittel der Chemischen Technik. Von A. Parnicke, Civil-ingenieur, vorm. Ober-ingenieur der Chemischen Fabrik Griesheim. (Frankfurt: H. Bechhold, 1894.)

WE are accustomed to hear little but praise of the German University system of education. There is, however, a reverse to the shield. While admitting the value of the training received by the University student in pure chemistry, the author of this work points out that only in a few of the higher technical schools is any systematic instruction given concerning the employment of machinery in manufacturing chemistry. The consequence is that many young chemists find, at the commencement of their practical career, that they have either to laboriously collect, from many scattered and not easily accessible sources, the information they require, or perforce remain mere copyists of the methods of others, for lack of the knowledge which might enable them to intelligently use the mechanical appliances best suited to attain their ends.

The work under review represents an endeavour to lessen the difficulties in this direction. In some 290 pages, a synopsis is presented of the principal mechanical arrangements with which the chemist may be concerned. A vast amount of information is set out in well-arranged sequence, and, though many of the descriptions are necessarily somewhat sketchy on account of the large number of appliances to be described, a study of the pages before us cannot fail to be of great use to the limited class for whom they were written. The book is well illustrated, having no fewer than 337 figures; these would have possessed a much greater value had dimensions been more generally given. From the point of view of the highly-trained chemist, it is perhaps to be regretted that valuable space is occupied by descriptions of certain machines of well-known types, such as common weighing machines. No doubt the volume is rendered more complete by the inclusion of such matter, yet it would seem of far greater importance that a chapter should have been added dealing with the many useful types of pressure and temperature regulators and their applications. It could hardly be expected that all parts of the book should be equally up to date; the account given of pyrometers is notably incomplete, no mention being made, for instance, of the now well-known instrument designed by Le Chatelier. English students may find in this compilation a useful index serving as a guide to direct their attention to the most important mechanical devices used in chemical operations; but we think that they will benefit more by undertaking the additional labour of unearthing details from the many admirable treatises and dictionaries already in existence in their own language. W. T.

Air, Water, and Disinfectants. (Manuals of Health Series.) By C. M. Aikman, M.A., D.Sc. Pp. 126. (London: S. P. C. K., 1895.)

THIS little book contrives to tell us a great many most interesting and instructive facts, without for one moment running the risk of boring us. It is written in an attractive style, and whilst popular, the author never forgets what is due to the subjects he is discussing.

Microbes, not perhaps, without reason, furnish material for a substantial portion of the text, and free use is made of "Our Secret Friends and Foes," which, however, Dr. Aikman amply acknowledges.

The little section on "Dust particles in the air" contains an interesting *résumé* of Dr. Aitken's investigations, and as they have been, we believe, chiefly published in Edinburgh scientific journals, will doubtless suggest much that is novel to the general reader. Many such will be astonished to learn "that a cigarette smoker sends 4,000,000,000 particles of dust, more or less, into the air with every puff he makes," and that one cubic inch of the air of a room at night, when the gas is burning, may contain as many dust particles as there are inhabitants of Great Britain!

We cordially recommend this little book to all those who wish to obtain an accurate, though popular, idea of the nature of air, water, and disinfectants.

An Elementary Text-book of Anatomy. By Prof. H. E. Clark. (London: Blackie and Son, 1895.)

A TEXT-BOOK of anatomy, suitable as an introduction to junior students of medicine, and simple enough to be understood by all who wish to read about the structure of their bodies. The book is limited to the anatomy of the human subject, and is divided into seven sections, dealing respectively with the tissues, bones, joints, muscles, vessels (the heart, blood-vessels, and lymphatic vessels), nervous system, and internal organs. It contains numerous instructive illustrations, as well as a useful glossary, and is altogether a serviceable elementary manual of anatomy.